

Research Newsletter

Responsive - Accessible - Relevant

A MESSAGE FROM THE RESEARCH DIRECTOR

By: Cameron Kergaye, PhD, PMP, PE

The Research Division held its annual workshop on March 24th, where 57 problem statements were discussed and prioritized for potential funding with over 100 participants. Final determination of next fiscal year's research projects at UDOT will involve review of the recommended funded projects list by the UTRAC council and approval by FHWA. While the new research projects will not begin until July 1st, we expect a tentative approval will allow technical teams to begin early discussions on scope of work.

The keynote address at the UTRAC workshop was delivered by UDOT's former executive director, John Njord. As a representative of an NCHRP consultant, Mr. Njord spoke on the topic of Foresight and strategic transportation research. NCHRP recently completed a six-volume series (NCHRP 750) examining long-range issues facing DOTs over the next 30 to 50 years. Mr. Njord stressed the need to plan for, and not predict, what may be needed in the future. The Foresight series covers technology adoption, socio-demographics and other areas, and may be found at TRB's website.

NCHRP's next round of research projects will also be determined very soon. UDOT ranked 49 of 122 submitted problems statements very high for FY 2016, and we are hoping that each one will gain enough support for funding. Last year 27 problem statements ranked high by UDOT were funded, which has translated into over \$15 million worth of NCHRP research of interest to Utah.

Also this is the time of year that AASHTO's Research Advisory Committee requests nominations for its 'High Value Research' award. This year we are submitting the following

three completed research projects: Evaluation of Grouted Splice Sleeve Connections for Precast RC Bridge Piers in ABC, Lessons Learned from a Pavement Marking Warranty Contract, and Review of Traffic Management Center Practices for Technological and Service Improvements. We look forward to sharing these projects with the nation.

Lastly, UDOT was awarded three SHRP2 assistance opportunities on March 27. This is for Round 5 implementation and technical assistance in the areas of renewal and capacity. The two renewal opportunities are for 3D Utility Locating and Railroad-DOT Mitigation, and the capacity opportunity is for Freight Planning. Congratulations to the engineers and technical support teams working on these projects!



Grouted Splice Sleeve Research

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Completed and Active Research Available at: www.udot.utah.gov/go/research

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2015 UTRAC Workshop and SHRP2 Updates

UTRAC Workshop

Thanks again to all who attended this year's UTRAC workshop and for submitting the great problem statements! We will be meeting in the next few weeks with the group leaders and the subject area leaders to determine if additional money is available and get approval of the selected new research projects. We hope to have a tentative list on the web in three to four weeks. However, the list won't be finalized until we meet with the UTRAC Council on May 7th.

If you missed the UTRAC workshop, this year the Trailblazer award was awarded to Patricia Cramer from USU's Department of Wildland Resources. We appreciate Patty's hard work on protecting the traveling public and our wildlife from wildlife-vehicle collisions through research and monitoring! In her presentation after the award, she gave thanks to many UDOT employess and other partners for their help with reducing wildlife-vehicle collisions. Thanks to all those involved!!



L to R: Cameron Kergaye, Patricia Cramer (2015 Trailblazer winner), Nathan Lee, Jason Richins

SHRP2 Round 5

On March 27, we found out that UDOT was successful in being awarded implementation assistance after applying for three additional SHRP2 solutions:

- 3D Utility Location Data Repository (R01A) – Proof of Concept
- Railroad-DOT Mitigation Strategies (R16) – User Incentive
- Integrating Freight Considerations into the Highway Capacity Planning Process (C15) – User Incentive

Congratulations to those that worked hard to fill out the applications and are planning to implement this new research!



SHRP2 Round 6

Round 6 of SHRP2 implementation assistance has also been announced with the application period running from May 29 to June 26. It has research solutions for:

- New Composite Pavement System (R21)
- Precast Concrete Pavement (R05)
- Utility Locating Technologies (R01B)
- Work Zone Impact Estimation Software (WISE) (R11)
- Identifying and Managing Utilities Conflicts (R15B)
- PlanWorks: Better planning, Better projects (C01)

More information on these can be found at:

<http://www.fhwa.dot.gov/goshrp2/ImplementationAssistance#round6>

If you are interested in more information on these solutions or are interested in applying, contact Jason Richins of UDOT's Research Division (jrichins@utah.gov). He'll be happy to help out!

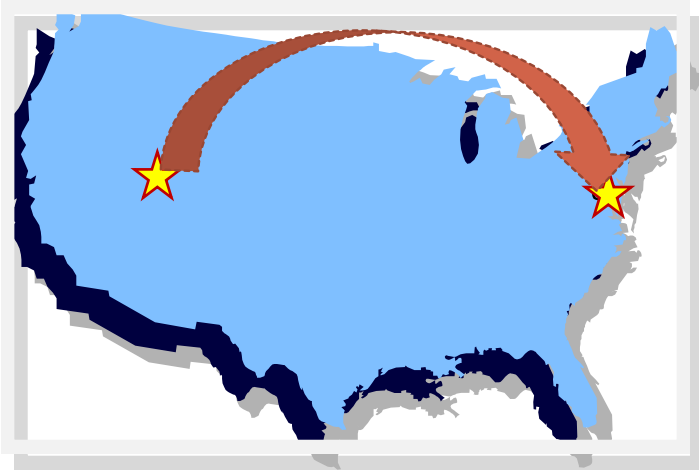
One can never consent to creep when one feels an impulse to soar.
—Helen Keller

Quote
Unquote

Don't bunt. Aim out of the ball park.
—David Ogilvy

A Bumper Crop of Great Ideas: Benefits of the TRB Annual Meeting

Based on past successes with the process, in January a group of thirteen UDOT leaders and engineers attended the [2015 Transportation Research Board \(TRB\) Annual Meeting](#) in Washington, D.C. to learn about the results of key transportation research and to network with others on best practices. Each UDOT attendee to the Annual Meeting brought back innovative, cost-saving ideas to implement at UDOT. In February this group attended the UDOT Leadership Team meeting to describe their implementation ideas.



Following is a list of many of the great ideas planned to be implemented at UDOT this year from the Annual Meeting:

- 3D design and construction on projects
- Risk-based methods to evaluate and implement 3D design of utilities
- Construction inspection priorities, resources, and quality
- Non-nuclear field test for aggregate, back-fill and soil density
- Permanent, fast-cure repair for concrete and asphalt pavements
- New perspective on managing pavement assets and performance
- Private sector perspective on safety culture and defensive driver course
- Behavior-based safety ideas
- Relationship between urban sprawl and motor vehicle crashes
- True cost for Zero Fatalities initiatives
- Workforce on-boarding, development, and knowledge management

- Proactive determination of back-up battery for signalized intersections
- First responder trauma support
- Wrong-way drivers detection and response
- Variable speed limit compliance
- Traffic data collection and analysis in the design process
- Extreme weather risk management
- New project technologies to prepare for automated vehicles
- Work times on projects based on driver behavior and capacity
- Geomembrane below pavement section at MSE walls for corrosion protection
- Corrosion potential tests for MSE wall backfill at 100% saturation or less to allow more borrow sources
- Strategic location of satellite salt facilities for efficient snow/ice control
- Minimizing salt usage through pre-wetting of solid salt during application, and basing application rates on storm type and the pavement temperature/condition
- Bicycling perspective on roadway design and operations (toolbox)
- Latest technologies and methods for conducting bicycle and pedestrian counts
- Tracking of research implementation

In November 2015 those who attended the 2015 Annual Meeting will share their idea implementation progress with the UDOT Leadership Team. This summer UDOT leaders will compile a list of people from UDOT who they feel would benefit from attending the 2016 TRB Annual Meeting and help implement great ideas when they return. Those who are selected to attend the 2016 Annual Meeting will also be invited to attend the November leadership meeting to learn about the process.

We look forward to learning about the new implementation successes at UDOT. For more information, contact Cameron Kergaye (ckergaye@utah.gov) or David Stevens (davidstevens@utah.gov) of the Research Division.

Comparison of Conventional and Internally Cured Concrete Bridge Decks in Utah: Mountain View Corridor Project

The long-term performance of concrete bridge decks is a function of the quality of concrete curing, especially in cold regions. During the weeks immediately following deck construction, high degrees of moisture saturation are desirable to ensure good concrete curing necessary for the concrete to develop both strength and durability, including a reduction in cracking susceptibility. One method of maintaining high degrees of moisture saturation in concrete immediately following deck construction is the use of pre-wetted, lightweight fine aggregate (LWFA). Although laboratory research has been performed and site inspections have been conducted on bridge decks with LWFA, information regarding in-situ deck properties such as moisture and diffusivity over time is not available in the literature.

Two objectives of this research were to 1) monitor in-situ moisture and diffusivity (in terms of electrical conductivity) for both conventional concrete and concrete containing pre-wetted LWFA and 2) compare deck performance in terms of strength, chloride ingress, and early-age cracking. The research involved field evaluations of four newly constructed bridge decks located along the Mountain View Corridor in northern Utah, two constructed using conventional concrete and two constructed using internally cured concrete containing pre-wetted LWFA. These decks were constructed in 2012.

Data from sensors embedded in the concrete decks indicate that the volumetric moisture content (Figure 1) and electrical conductivity of the internally cured concrete were higher than those of the conventional concrete during the 2-year monitoring period. Also as measured in the field, the internally cured concrete was weaker, or less brittle, at 2 years in Schmidt rebound hammer testing and exhibited greater

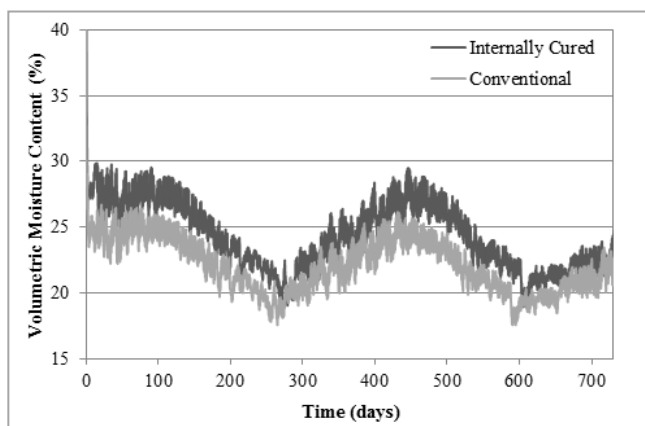


Figure 1. Moisture content of internally cured and conventional concrete bridge decks at 8200 South.

chloride concentrations at both 1 and 2 years than the conventional concrete. The conventional concrete bridge decks had more reflection cracking from the joints between the underlying pre-cast half-deck panels than the internally cured concrete decks (Figures 2 and 3).

The use of pre-wetted LWFA to promote internal curing within concrete is recommended for reducing the occurrence of cracking in concrete bridge decks in Utah. However, as demonstrated in this research, internally cured concrete will not achieve its maximum potential in terms of crack reduction when half-deck concrete panels are used in deck construction. Comparing the loss in deck service life from premature cracking with the benefits of accelerated construction resulting from the use of half-deck concrete panels is recommended for future deck designs. Further research evaluating chloride ingress in internally cured concrete decks should also be considered.



Figure 2. Distress map for 8200 South internally cured concrete bridge deck at 2 years.

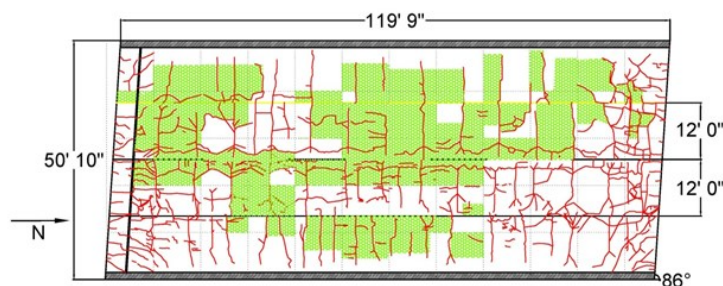


Figure 3. Distress map for 8200 South conventional concrete bridge deck at 2 years.

The deck sensors will continue to be monitored into 2016. For more information, see the study report on the UDOT Research Division website, or contact Spencer Guthrie of BYU (guthrie@byu.edu) or Thomas Hales of the UDOT Research Division (tahales@utah.gov).

Non-Consent Tow Truck Costs in Utah

This study was conducted in 2014 for the UDOT Motor Carrier Division, in coordination with the towing industry in Utah, to evaluate the maximum allowable rates for “Non-Consent Towing”. This is a term used to describe towing where the vehicle owner did not request or negotiate the towing service. Examples include: accidents, disabled vehicles, police impounds, and vehicles improperly parked on private property (businesses). Currently the Motor Carrier Division has the responsibility for setting the maximum allowable rates for non-consent towing in Utah. The Utah Highway Patrol and municipalities have their own contracts and rotation lists with towing businesses, and they observe the statewide maximum allowable rates. Private consultants were used for this study to provide a neutral and independent evaluation of the current costs.



The objectives of the study were to: 1- Evaluate the current “maximum” pricing levels for non-consent towing, 2- Recommend indexes to allow for future changes in costs, and 3- Identify other price factors that may have an influence on costs to the towing industry.

A cost analysis was used to estimate the expenses that the towing companies incur during typical towing operations. The data used was obtained through surveys, interviews, and literature. The total costs for each of the fee categories (tow fee, administrative fee, and storage yard fee) were calculated. Background information and access to databases were provided by the Motor Carrier Division and members of the Utah towing industry. Many factors were included in estimating the costs to the towing industry. Additional analyses were conducted for the following business models: full-time

towing companies, mixed-business companies, and part-time towing.

Following are the main findings from the study:

1. The estimated expenses for all fee categories were found to be below and similar to (within 5-10%) the current maximum allowable rates.
2. Because the estimated maximum fees were less than but similar to the current allowable maximum rates, neither an increase nor a reduction in these rates was recommended.
3. Several cost of living indexes were found with the Bureau of Labor Statistics, which routinely tracks costs for labor, goods and services. Two cost of living indexes were identified which can be used for estimating and adjusting for costs within the Tow Fee Category: *Light Truck Driver Salary*, and *the Tow Truck Index*. Two similar indexes were found for use in estimating and adjusting for the costs in the Administrative Fee Category: *Office Clerk Salary*, and *the Office Space Index*.
4. Implementation of uniform rules and policies could reduce costs to the towing companies in Utah.
5. Objective criteria should be used to select companies onto rotation lists (capabilities and past performance), and others to evaluate their performance on the rotations (ongoing performance measures).
6. Because non-consent towing is a crucial part of roadway safety and congestion management, the use of performance criteria, such as required response time regulations, is appropriate on most highways.

The Motor Carrier Division and the Motor Carrier Advisory Board are looking into ways to implement the findings. For more details on the study, see the final report on the UDOT Research Division website or contact Douglas Anderson (doug.atc@q.com), Chad Sheppick (csheppick@utah.gov) of the Motor Carrier Division, or David Stevens (davidstevens@utah.gov).

Rapid Concrete Bridge Deck Condition Assessment: Vertical Impedance and Acoustic Impact-Echo Testing

In cold regions, applications of deicing salts frequently lead to chloride-induced corrosion of reinforcing steel and subsequent delamination of concrete bridge decks. Understanding the degree of deterioration of a bridge deck is important for determining appropriate maintenance and rehabilitation strategies. However, conventional methods of assessing the condition of concrete bridge decks are not only time-consuming, but they do not typically permit investigation of the full deck area. Methods for more rapidly evaluating concrete bridge decks are therefore needed.

To that end, the objective of this research was to demonstrate the utility of new vertical impedance and acoustic impact-echo testing devices recently developed at Brigham Young University (BYU). Both devices permit continuous data collection from a moving platform and were demonstrated on a bridge in Clearfield, Utah. Originally constructed in 1972, the bridge has 11 spans, extending over a length of 1425 ft, and an area of 40,600 ft². The original 7.5-in.-thick deck received a 1-in.-thick concrete overlay in 1973 and a nearly 0.5-in.-thick polymer surface treatment about 30 years later.

For impedance testing, the researchers connected the testing device to the reinforcing steel (uncoated) and obtained measurements along each of nine longitudinal lines along the bridge deck. Impedance data were collected using a rolling probe, and each pass along the length of the bridge required about 40 minutes. Impact-echo testing was performed along each of 12 longitudinal lines along the bridge deck and required about 20 minutes per line. The echoes were recorded, and a computer algorithm newly developed at BYU was used to automatically determine the presence and location of delaminations on the deck. For comparison purposes, half-cell potential testing, chaining, and coring were also performed.

The results of the impedance testing, half-cell potential testing, impact-echo testing, and chaining are presented in Figure 1 (not drawn to scale) on the following page. The black dots, which appear as lines in some figures due to their close proximity to each other, indicate

the locations of actual measurements. For display and analysis purposes, a cubic interpolation function was used to generate values between the locations of actual measurements.

The vertical nature of the impedance testing allows interrogation of all layers from the deck surface down to the reinforcing steel, specifically permitting evaluation of the total protection against chlorides provided by any deck surface treatments, the full depth of the concrete cover, and any rebar coatings. On the impedance map, areas characterized by lower reinforcing steel protection are marked in red, while areas characterized by higher reinforcing steel protection are marked in blue. The spatial variation in impedance is substantially similar to the spatial variation in half-cell potential, for which areas of concern are also marked in red.

The maps prepared from the impact-echo and chaining data are also generally in good agreement, with areas of concern marked in green, yellow, and red; differences between the data sets can be attributed to the fact that the occurrence of patching, whether attended by delamination or not, is represented in the manual chaining data whereas only delaminations are represented in the impact-echo data. (Specifically, in the maps of the chaining data, a value of "0" indicates no delamination or patching, a value of "1" indicates delamination only, and a value of "2" indicates a patch, with or without delamination.)

For coring, the researchers specifically identified 13 locations on the deck that represented different levels of impedance magnitude and half-cell potential in combination with the presence or absence of delamination and/or patches to enable examination of a wide range of possible deck conditions. At every location, the results of coring were consistent with the results of the non-destructive testing. Additional research is underway at BYU to further improve the speed of data collection for both the vertical impedance and acoustic impact-echo testing devices.

Rapid Concrete Bridge Deck Condition Assessment: Vertical Impedance and Acoustic Impact-Echo Testing (cont.)

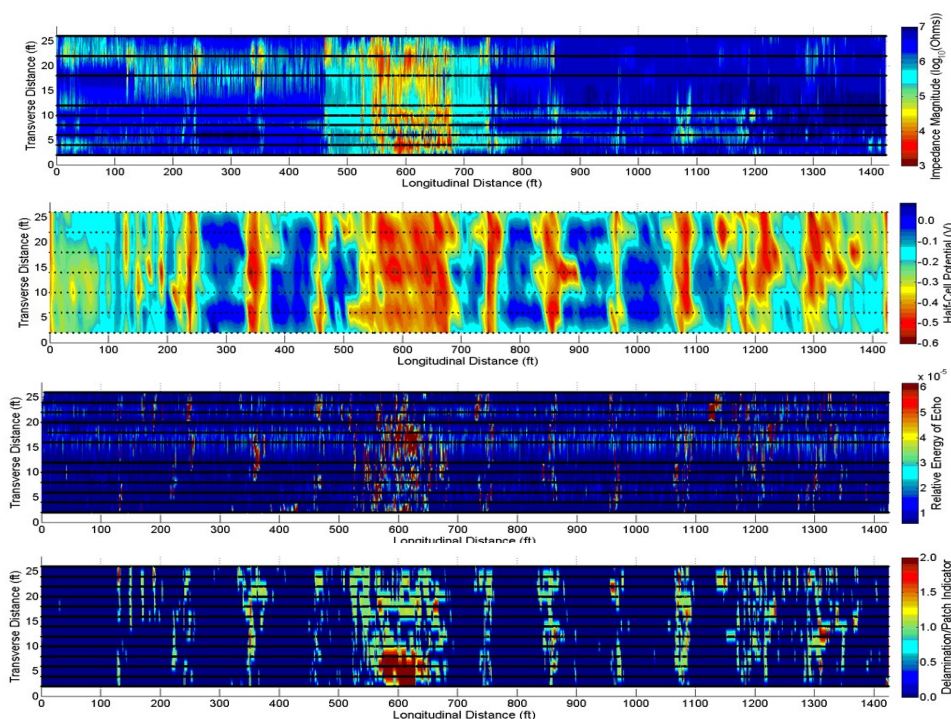


Figure 1. Vertical impedance, half-cell potential, acoustic impact-echo, and chaining maps for the Clearfield bridge deck.

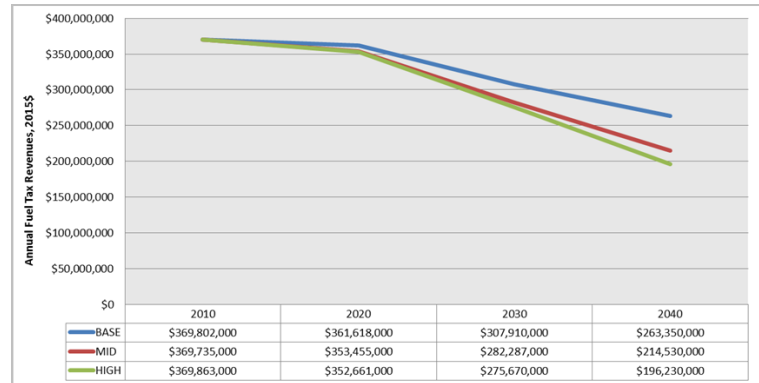
For more information, contact Spencer Guthrie of Brigham Young University (guthrie@byu.edu) or Jason Richins from UDOT's Research Division (jrichins@utah.gov).

Potential Revenue Impacts of High-Efficiency Vehicles on Utah State Gasoline Tax Revenues 2020-2040

High-efficiency motor vehicle use (including electric, hybrid, natural gas and other alternative fuel vehicles) is on the rise in Utah. New light duty vehicles with standard gasoline-powered engines are more efficient to comply with recently adopted Corporate Average Fuel Economy (CAFE) standards. As the motor vehicle fleet in Utah becomes more efficient, using less gasoline per mile traveled, there is a potential for a significant slowing in the growth or a reduction of revenue from this revenue source, decreasing the State's ability to deal with the operational and maintenance impacts to highway infrastructure associated with increasing population and travel demand.

It is critical to also account for anticipated efficiency gains for heavy-duty vehicles, since they consume 25% of all fuel despite being less than 10% of vehicles on the road. Phase I heavy-duty vehicle standards established modest improvements in fuel efficiency to 2017. In Spring 2015 the Phase II heavy-duty fuel efficiency standards are expected to be announced. Efficiency gains of almost 40% may be possible. Alternative truck fuels such as CNG will also affect overall revenues from motor fuel sales.

Our research looked at three possible scenarios – Base Case, Mid and High – that were simulated in the Utah EERPAT model to generate estimates of future fuel tax revenues. Fuel taxes are levied for each gallon of gasoline or diesel (special fuel) purchased, as well as for each gallon-of-gas equivalent of CNG purchased. Historical state fuel tax rates have been 24.5 cents per gallon for gasoline and diesel, and 8.5 cents per gallon-of-gas equivalent for CNG. The following graph shows the combined impact both of eroded buying power of these rates due to inflation assuming an average annual inflation rate of 1.7% (Base Case) and of greater penetration of alternative drive-train vehicles (hybrid, plug-in hybrid, battery electric) (Mid and High).



Projected Annual Fuel Tax Revenues, Alternative EV Market Share Scenarios (2015\$)

The analysis, completed prior to the conclusion of the 2015 Legislative Session, assumed no increase in the gas tax over the forecast time horizon. With the new tax formulas approved by the Legislature that are intended to offset inflation, the relative impact of high-efficiency vehicles becomes the next revenue impact to focus on. That impact is not currently a pressing concern, even in the aggressive High scenario, due to the relatively slow anticipated rate of replacement of existing gasoline vehicles with alternative drive trains, but it will eventually become so. The Legislature also approved further research into evaluating the feasibility of implementing mileage-based road user charges to eventually supplement or replace current fuel taxes. *(The Final Report for this project was in draft form at the time of newsletter publication, but will be available shortly.)*

For more information contact Kevin Nichol of the UDOT Research Division (knichol@utah.gov) or Robert Chamberlin (bob.chamberlin@rsginc.com) of Resource Systems Group (RSG).



Leadership Book Discussion: Review of *The Speed of Trust*

Many UDOT employees accepted the invitation to read the book ***THE SPEED OF TRUST*** by Stephen M. R. Covey. Due to the number of pages, it was recommended to read up to page 124 (end of First Wave) by March 25 at which time we had the opportunity to discuss and review it with Shane Marshall. However, if you haven't had the chance to jump in on the fun yet, it's not too late, because our next goal is to read up to page 232 (end of Second Wave) by May 5, at which time we will have another group review and discussion opportunity with Shane Marshall.

**Did you know...?
Trust is not just based on a
person's character.**

**Find out why and the other essential
ingredient to Trust in Chapter 1!**

There is a direct relationship between the success of a business and the level of trust that exists within that business. In the words of Jim Burke, former Chairman and CEO of Johnson & Johnson (as shared in the book):

"You can't have success without *TRUST*. The word *TRUST* embodies almost everything you can strive for that will help you to succeed. You tell me any human relationship that works without *TRUST*, whether it is a marriage or a friendship or a social interaction; in the long run, the same thing is true about business, especially businesses that deal with the public."

**Are you a trustworthy
person?**

**Discover the critical elements that
make you more trustworthy in
Chapter 2!**

As shown in the following table, there are some common misunderstandings about the power of trust which sometimes hold us back.

Myth vs. Reality	
<i>Myth</i>	<i>Reality</i>
Trust is soft.	Trust is hard, real and quantifiable. It measurably affects both speed and cost.
Trust is slow.	Nothing is as fast as the speed of trust.
Trust is built solely on integrity.	Trust is a function of both character and competence.
You either have trust or you don't.	Trust can be both created and destroyed.
Once lost, trust cannot be restored.	Though difficult, in most cases lost trust can be restored.
You can't teach trust.	Trust can be effectively taught and learned, and it can become a leverageable, strategic advantage.
Trusting people is too risky.	Not trusting people is a greater risk.
You establish trust one person at a time.	Establishing trust with the one establishes trust with the many.

This is truly a great read that not only gives inspiring ideas for use in our careers but also in our personal lives. Copies of the book can be checked out from Joni DeMille (jdemille@utah.gov) in the UDOT Library.

RESEARCH CALENDAR OF EVENTS

RESEARCH FUNDING OPPORTUNITIES (click to see the full document)

NCHRP Project 20-7 Proposals (Submitted by AASHTO Committees Reporting to the Standing Committee on Highways), DUE on April 15, 2015

TCRP FY 2016 Problem Statements, DUE on June 15, 2015

Round 6 of SHRP2 Solutions Implementation Assistance Applications, DUE on June 26, 2015



WEBINARS (Click to see webinar details)

Title	Day/Date	Time
Rigid Pavement Preservation: Research Results (TRB)	Wednesday, April 8	9:00 AM – 10:30 AM
Safety and Financial Impacts of Airport Winter Operations (TRB)	Thursday, April 9	12:00 PM – 1:30 PM
Achieving Sustainable Transportation through Collaboration (TRB)	Tuesday, April 14	11:00 PM – 12:30 PM
Creative Ways to Consider Funding Future Transportation (TRB)	Wednesday, April 15	12:00 PM – 1:30 PM
Tools for Analysis of Capacity and Efficient Flow for Roundabout Design: Part I (TRB)	Wednesday, May 6	11:00 AM – 1:00 PM
Effective Practices for the Protection of Transportation Infrastructure from Cyber Incidents (TRB)	Wednesday, May 13	12:00 PM – 2:00 PM
Use and Implementation of the FHWA Stochastic Empirical Loading and Dilution Model (SELDL): Oregon & Massachusetts (TRB)	Monday, May 18	11:00 AM – 12:30 PM
Creating a Workplace That Really Works	On Demand	On Demand
Stop People from Wasting Your Time	On Demand	On Demand
Refiring in All Areas of Your Life: Four Essential Strategies	On Demand	On Demand